Case Report

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Apexification with white MTA in an immature permanent tooth with dens invaginatus

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Abstract

Dens invaginatus, also known as "dens in dente", is a developmental dental anomaly resulting in an invagination of the enamel organ into the dental papilla. These cases present technical difficulties to the root canal treatment. Apexification using an apical plug of mineral trioxide aggregate (MTA) has been indicated as an alternative to long-term intracanal use of calcium hydroxide in immature permanent teeth. It is considered as a simple and rapid technique. This paper reports a case of Oehlers' Type 1 dens invaginatus in an immature permanent maxillary right lateral incisor, which presented pulp necrosis secondary to dental trauma and was treated by apexification with white MTA apical plugging followed by conventional root canal therapy. The operative procedures are described and the technique is discussed. The physical and biological properties of MTA, associated with appropriate instrumentation and obturation techniques, make this material an excellent option in the endodontic therapy of immature permanent teeth with dens invaginatus.

Keywords: dens invaginatus, dens in dente, apexification, mineral trioxide aggregate, calcium hydroxide.

Introduction

The term dens invaginatus was coined in 1953 by Hallet[1,] who made the first documented attempt to classify invaginated teeth, suggesting the existence of four types of invagination based on both clinical and radiographic criteria. This is a term that applies for all of variants of this developmental dental anomaly, which results from an alteration in the normal growth pattern of the dental papilla during odontogenesis, showing a wide array of anatomical variations[2-6]. The classification system proposed by Oehlers[2] in 1957 is probably the most clinically relevant and is by far the most commonly used in clinical studies, case reports and case series[6-9]. It is based on Hallet's original classification[1], but the cases are grouped in three major categories, according to the depth of the invagination and the existence of communication with the pulp tissue or periodontal ligament, regardless of the affected tooth (anterior, posterior, supernumerary). A single tooth can present multiple invaginations, but each one may fall into a different classification: Type 1 - the invagination is confined to the tooth crown, being limited to enamel and not extending beyond the cementoenamel junction (CEJ); Type 2 - the invagination extends apically beyond the CEJ and may or may not have pathways of communication with the dental pulp; Type 3 - the invagination extends apically beyond the CEJ and a second foramen is evident in the periodontal region. There is

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no communication with the pulp.

New perspectives arose in the practice of dentistry with the development of mineral trioxide aggregate (MTA). MTA has been indicated in endodontics for treatment of perforations, retrograde fillings, pulpotomy and as an apical barrier in cases of immature non-vital teeth, also has antimicrobial properties[10-12]. It has been extensively demonstrated that MTA is a biocompatible material that stimulates the formation of new cementum on its surface and provides good seal[10,12-16]. White and gray MTA present similar chemical composition and biological properties[12,14,17-18].

The use of an apical plug of MTA has been indicated as an alternative to long-term intracanal use of calcium hydroxide for root-end closure of non-vital immature permanent teeth[19-23]. Apical plugging with MTA is a simple and rapid technique that eliminates the need of successive intracanal dressing changes[10,21]. Some authors, however, have advocated that the use of calcium hydroxide-based intracanal dressing followed by preparation of an apical MTA plug should be the treatment of choice for apexification of teeth with incomplete apex formation[3,13,18,24].

This paper reports a case of Oehlers' Type 1 dens invaginatus in an immature permanent maxillary right lateral incisor, which presented pulp necrosis secondary to dental trauma and was treated by apexification with white MTA apical plugging followed by conventional root canal therapy.

Case Report

A 9-year-old male child presented for treatment 1 day after sustaining a trauma to the maxillary right lateral incisor. The intraoral clinical examination showed no soft tissue lacerations, no crown or root fracture and no mobility. The preoperative periapical radiograph (Figure 1) showed incomplete root formation with open apices and Type 1 dens invaginatus according to Oelhers' classification. No significant periapical alteration was observed. Since the tooth did not respond to cold and hot stimuli, the patient was scheduled for reevaluation within 2 weeks, but he did not show up. The patient returned 3 months later with a fistula associated with the apical region of the traumatized tooth. A new periapical radiograph showed the development of apical periodontitis (Figure 2).

Considering the mode of treatment that is commonly adopted for cases of apexification[7,13,18,24], the initial treatment plan was apexification mediated by changes of calcium hydroxide-based intracanal pastes followed by definitive obturation. The coronal access was prepared through the invaginated portion. Monthly changes of the calcium hydroxide-based intracanal medication were done during 6 months, but no progress in apex closure was observed. Therefore, an attempt was made to induce apexification by the placement of an apical plug with white MTA (Angelus Dental Solutions, Londrina, PR, Brazil). After local anesthesia and rubber dam isolation, the provisional restoration was removed access to the root canal was gained. A new determination of root canal length was done with a size 80 K-file, and the total root length was established as being 20 mm (Figure 3). The root canal was instrumented with a size 80 K-file, irrigated with a 1% sodium hypochlorite solution followed by a final flush with EDTA (Byodinamic Europe S.L., Ibiporã, PR, Brazil) and dried with sterile absorbent paper points. The MTA powder and liquid components were mixed according to the manufacturer's instructions and a size 70 K-file was used to prepare a 4-mm-thick apical white MTA plug by repeated movements of file insertion and removal in an anticlockwise direction (Figure 4). Excess MTA was removed from the canal walls and the remainder of the canal was obturated by lateral condensation of gutta-percha

Fig. 1. Preoperative periapical radiograph showing incomplete root formation and Oehlers' type 1 dens invaginatus.

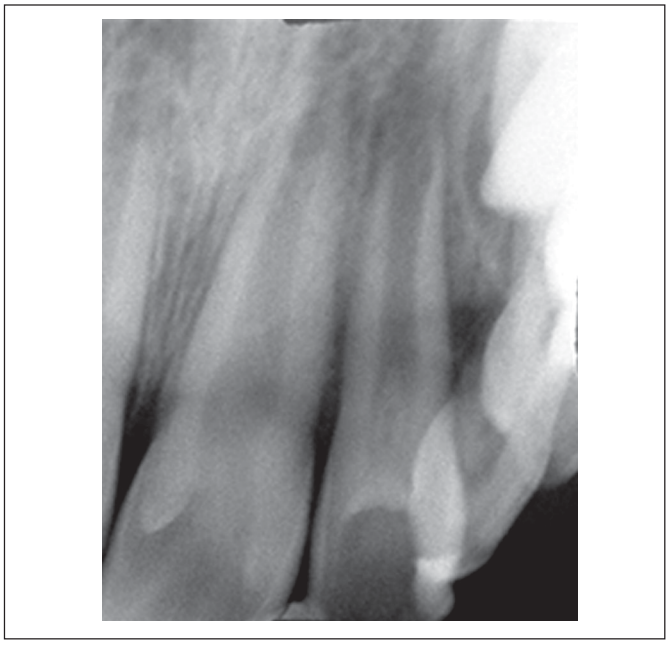

Fig. 2. Periapical radiograph showing the development of apical periodontitis associated with the traumatized tooth 3 months after the first visit.

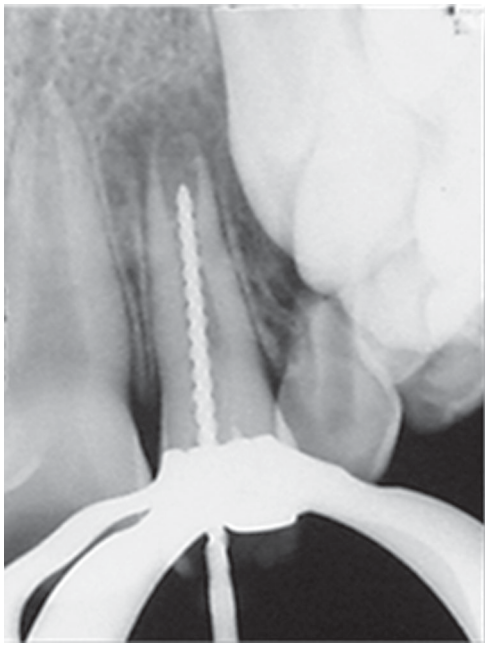

Fig. 3. Periapical radiograph of root canal length determination with a size 80 K-file.

Fig. 4. Periapical radiograph showing the apical white MTA plug.

and Sealer 26 endodontic sealer (Dentsply Industry and Trade Ltda., Rio de Janeiro, RJ, Brazil). The coronal portion was restored with composite resin. The final radiographs showed a well-obturated root canal. The 21-month post treatment follow-up showed clinical and radiographic success (Figure 5).

Discussion

The etiology of dens invaginatus remains controversial. Most authors[2,5-6,9,25] describe its origin in a distortion of the enamel organ causing a protrusion inside the dental papilla, which produces an invagination of the tooth crown before

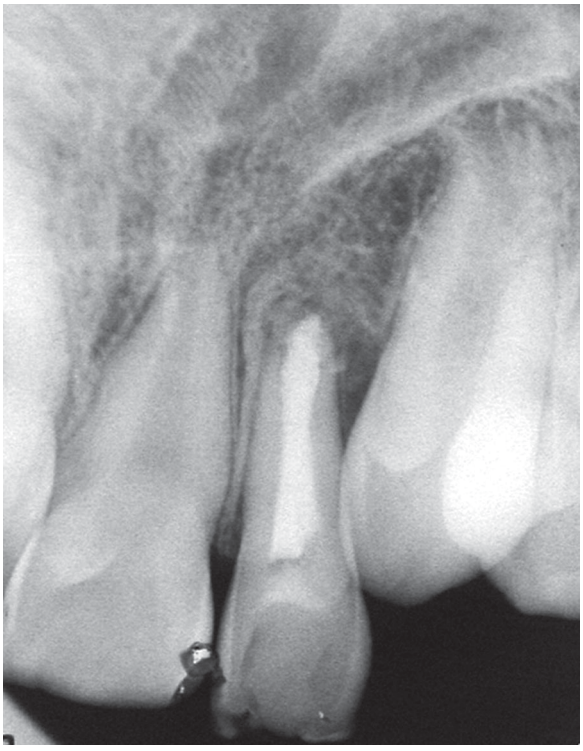

Fig. 5. Periapical radiograph after 21 months of follow-up.

calcification. Also, a genetic source may be a significant factor[6,8,26]. According to the literature, the prevalence of dens invaginatus ranges from 0.03 to 10%[4,6,26-27] and there is a female-to-male predominance of 3:1[6]. The permanent maxillary right lateral incisors are the most commonly affected teeth[4,6,26], being bilateral in over 40-43% of the cases[5,8-9,25], followed in a decreasing order of prevalence by central incisors, canines, premolars and molars[7]. The importance of an accurate and early diagnosis is justified because pathways of communication with the oral cavity can be created in invaginated teeth. This permits the penetration of irritating agents and microorganisms into the pulp tissue and leading to potential complications, namely caries disease, internal resorption, pulp necrosis, apical periodontitis and apical cyst formation[2,8,26].

In the present case, the tooth was classified as having dens invaginatus Type 1, according to Oehlers' classification[2]. Depending on the type of malformation and the communication of the invagination with the pulp tissue, the clinician may confine the endodontic therapy to the invaginated portion and, as a result, preserve pulp vitality. However, in most cases, the endodontic treatment must include both the invagination and the root canals. The task can become even more challenging, considering the multiple anatomical variations that a dens invaginatus may present within the root canal system. Complete debridement of the root canal system can be compromised by limited access and as a result some areas may remain uninstrumented when a conventional technique is used. In order to overcome these limitations, some researchers have suggested that the invagination is removed under the operating microscope[26]. In the present case, the access

to the canals was gained through the invaginated portion. If nonsurgical endodontic therapy fails, a combined approach with apical surgery may be indicated.

Pulp involvement can occur at an early age when the roots are not completely formed. The large and irregular volume of the root canal system of invaginated teeth is an additional challenge for cleaning, shaping and instrumentation.

The endodontic therapy of choice for non-vital immature teeth is apexification, which is the induction of apical closure to produce more favorable conditions for conventional root canal filling. Calcium hydroxide is the most commonly advocated medicament because, in addition to a low cost, its efficacy to induce the formation of an apical mineralized barrier is well documented[15,16] even in cases of dens invaginatus with necrotic pulp[7,9,27]. However, apexification with calcium hydroxide requires successive changes of the intracanal medication that may last for several months, which may increase the risk of coronal leakage and recontamination of the root canal system. In addition, there have been reports on the decrease of the fracture strength of teeth subjected to long-term intracanal use of calcium hydroxide to induce apexification[13,15,20] and considerable interest has been expressed in the use of other materials, such as MTA.

The use of MTA alternatively to calcium hydroxide has become increasingly widespread. Several studies[10,22,28-29] showed that pediatric dentists in the world had used MTA or arranged for its use in apical barrier formation in non-vital immature permanent teeth. Kusgoz et al.[10] and Erdem and Sepet[21] reported clinical cases in which MTA was used as a filling material in traumatized teeth with necrotic pulp and open apices and concluded that MTA can be considered a very effective option for apexification of traumatized and immature permanent teeth with the advantage of shorter treatment time, good sealing ability and high biocompatibility. D'Arcangelo and D'Amario[18] reported two cases of apexification with apical MTA plug after intracanal use of calcium hydroxide, in the same way as used in the present study. The presentation of these cases confirms that MTA acts as an apical barrier and can be considered as an effective material to support regeneration of apical tissues in immature teeth with necrotic pulp for both young and adult patients.

MTA may be used in the treatment of dens invaginatus[3,26]. Bogen and Kuttler[30] report a Type 2 dens invaginatus with periapical periodontitis treated using an apical plug of MTA. A paper describes the use of MTA in two cases of dens invaginatus which were prepared with ultrasonic instrumentation under magnification[26]. Silberman et al.[25] reported a case of dens invaginatus in an immature tooth that was successfully treated with the placement of an apical plug of gray MTA and conventional endodontics. In the present case, the apical plug was prepared with white MTA, which has similar properties[14,23].

In conclusion, apical plugging with MTA for induction of apexification allows for completing the treatment in a single session, which can be preceded by another session for placement of a calcium hydroxide-based intracanal medication in teeth with infected root canals. The physical and biological properties of MTA, associated with appropriate instrumentation and obturation techniques, make this material an excellent option in the endodontic therapy of immature permanent teeth with dens invaginatus.

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